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# A SYSTEMATIC ANALYSIS OF THE PINE PITCH MIDGES, CECIDOMYIA SPP. (DIPTERA: CECIDOMYIIDAE)

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This publication was prepared by the Science and Education Administration's Federal Research staff, which was formerly the Agricultural Research Service.

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# A SYSTEMATIC ANALYSIS OF THE PINE PITCH MIDGES, *CECIDOMYIA* SPP. (DIPTERA: CECIDOMYIIDAE)

By Raymond J. Gagné, research entomologist<sup>1</sup>

## ABSTRACT

The genus *Cecidomyia* contains 11 species, 8 from North America and 3 from Eurasia. Most are only broadly host specific and occur on many species of pines in North America and also spruce and fir in Europe. The larvae feed on pitch and can cause extensive primary damage. The species are analyzed

by use of a cladogram, and the North America species are keyed, described, and their pertinent taxonomic characters illustrated. New species described are *C. brevispatula*, *C. fortunactus*, *C. reburrata*, and *C. tortilis*.

## INTRODUCTION

The genus *Cecidomyia* contains the "pine pitch midges," whose larvae feed on the resin of conifers, mainly pines. Eleven species are known—eight from North America and Cuba, two from Europe, and one or possibly two from the Himalayan region. They are primary feeders and cause extensive damage to pines, especially in North America. The larvae form pits or resinous nodules in twigs, branches, and cones, where they live completely submerged in the accumulated resin except for their protruding hind spiracles.

The genus belongs to the supertribe Cecidomyiidi. The adult flies may be separated from those of other genera by the following combination of characters: The tarsal claws are shorter than the empodia, untoothed, and bent beyond midlength; the basimeres are stout and unlobed basally, and the male tergum and sternum X are of approximately equal length; the ovipositor is protrusible although not very long; the antennal flagellomeres I-II are not connate; and the palpi have three or four segments. For a key to genera of North American Cecidomyiidi, see Gagné (1973).<sup>2</sup> The larvae are spin-

dleform, and the hind spiracles are at the extreme end of the body. They are the only cecidomyiid larvae found submerged in conifer resin.

This is the first complete taxonomic revision of *Cecidomyia*, although Barnes (1951) reviewed the literature to about 1950, and Vockeroth (1960) in his study of the species on jack pine (*Pinus banksiana* Lamb.) reviewed much of the previous taxonomic literature. Vockeroth implied a narrow host specificity to *Cecidomyia* species by treating his three species from jack pine as distinct from those previously described from *Pinus radiata* D. Don., *P. rigida* Mill., and *P. virginiana* Mill. To the contrary, most of the Nearctic species that occur on hard pines (*Pinus*, subgenus *Diploxylon*) have a wide host range. I found six species of *Cecidomyia* in a small grove of *P. virginiana* in Montgomery County, Md. Three of them occur from coast to coast on several species of pine. The other three are also on at least one other pine species in eastern North America. On the other hand, *Cecidomyia candidipes* Foote is known exclusively from white pine (*Pinus strobus* L.), although it may yet be found on other soft pines (*Pinus*, subgenus *Haploxylon*) in western North America as that region becomes better collected.

*Cecidomyia* larvae are usually easy to find and rear to the adult stage in early spring, although they may not be present on some trees and stands. Full-grown orange larvae, 5-10 mm in length, can be seen

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<sup>2</sup>The year in italic after the author's name indicates the reference in Literature Cited, p.9.

in small pitch-filled crevices or large nodules and pitch masses (figs. 2-3) in early to mid-April near Washington, D.C. Larvae in twigs brought indoors and placed in plastic bags soon pupate and adults emerge shortly after. The larvae either remain in the pitch masses to pupate or leave depending on the species. Those remaining in the pitch pupate in a silken cylinder, which effectively separates the pupae from the resin. When the adult is fully formed, the pupa pushes through a thin cap of dried resin to the

outside, a split develops along the dorsum of the pupal thorax, and the adult emerges. Larvae of those species that pupate apart from the pitch mass have distinctive dorsal abdominal tubercles (fig. 27), whose function is unknown. Each larva forms a white cocoon (fig. 4), which, when formed on a pine needle, is fairly conspicuous. The pupa escapes through a circular cap at the anterior end of the cocoon, and the adult then breaks out of the pupal skin.

## Genus CECIDOMYIA Meigen

*Itonida* Meigen, 1800: 19. Type-species, *Tipula pini* De Geer (Coquillett, 1910: 556). Suppressed by International Commission on Zoological Nomenclature (1963: 339).

*Cecidomyia* Meigen, 1803: 261. Type-species, *Tipula pini* De Geer (monotypic).

*Cecidomyia*, subgenus *Diplosis* Loew, 1850: 20. Type-species, *Tipula pini* De Geer (Rondani, 1860: 289).

*Cryptodiplosis* Kieffer, 1895: cxciv. Type-species, *Tipula pini* De Geer (orig. designation). Synonym by Kieffer (1913: 211).

*Retinodiplosis* Kieffer, 1912: 1. Type-species, *Diplosis resinicola* Osten Sacken (orig. designation). Synonym by Vockeroth (1960: 65).

*Stelechodiplosis* Möhn, 1955b: 141. Type-species, *Stelechodiplosis magna* Möhn (orig. designation). Synonym by Vockeroth (1960: 66).

**Adult.**—Head as in figures 6-7. Eyes broadly confluent at vertex, facets closely juxtaposed, hexagonal. Postvertical peak absent. Antenna with 12 flagellomeres, I and II not connate; male flagellomeres binodal, tricircumfilar; female flagellomeres cylindrical, their two circumfila connected by two longitudinal strands. Palpus four-segmented, except three-segmented in *C. piniinopis*. Wing  $R_5$  curved distally, joining C posteriad of wing apex; C broken at juncture with  $R_5$ , Rs weak;  $M_{3+4}$  fold present; Cu forked. Legs usually covered with brown scales, but *C. candidipes* white on distal three hind tarsomeres; tarsal claws simple, curved beyond midlength; empodia slightly longer than claws. Male abdomen: Terga I-VI large, rectangular, with approximately two rows of caudal setae, a group of lateral setae, and scattered narrow scales elsewhere; tergum VII as for VI except shorter, caudal setal rows interrupted mesally; tergum VIII very short, barely sclerotized, naked except for pair of trichoid sensilla; sterna II-VII quadrate, with two to three rows of caudal setae, scattered setae elsewhere, denser laterally, and scattered narrow scales; sternum VIII less sclerotized than preceding, with only basal pair of trichoid sensilla and apical setae; basimere unmodified, except

very large, produced apicolaterally to partially envelop telomere in *C. tortilis* and *C. reburrata*; telomere short or long, variously shaped, setose throughout, setulose on basal two-thirds, striate on distal third; tergum X with fold at midlength, cerci triangular; sternum X narrow to wide, simple to deeply lobed; aedeagus simple, long to short, rounded or blunt apically. Female abdomen: Terga I-VII as for male except VII as long as preceding tergum; sterna I-VII as for male; tergum VIII rectangular, with basal pair of trichoid sensilla and scattered setae on distal half; sternum VIII not apparent; ovipositor short, protrusible, with scattered short setae laterally and ventrally; tergum X lightly sclerotized, with scattered short setae; cerci with two short, apical sensoria, covered elsewhere with dense, short setae.

**Pupa.**—Antennal horns rounded, crested, or peaked. Pronotum variable, with two pairs of setae. Frons with two pairs of setae. Face with group of three papillae at base of each palpus. Prothoracic spiracles variously shaped, variable within species. Abdomen covered with minute spicules.

**Larva (figs. 27-28).**—Head capsule with very long apodemes. Sternal spatula of third instar variously shaped or absent. Papillae as follows: Laterals on thoracic segments in two groups of three each per side, two of each group with short seta; four fore ventrals and two hind ventrals, all unhaired; two haired pleurals per side, in some species abdominal pleurals situated on tubercles; six dorsals (except abdominal segment VIII with two (homologous with middle pair on previous segments)), each with seta except middle pair sometimes without, lateral pairs of abdominal dorsals in some species each situated at end of common, long, cephalocaudally flattened tubercle, middle pair of papillae sometimes situated on short tubercles; terminals primitively four per

side, one to two lost or not apparent in some species, at least one with cylindrical peglike seta, one with long, tapered seta. Hind spiracle greatly enlarged, projecting caudad of anal ("terminal") segment, in first instar terminating in single point, in second instar in two, and in third instar, in four.

**Remarks.**—*Cecidomyia* is distinctive and readily keyed (Gagné, 1973), but I cannot bring its affinities with other genera into focus except to place the genus within the large mass of phytophagous Cecidomyiidi. Since the adult characters are basic to the supertribe, although diagnostic, they do not lend themselves to clarifying relationships. The adult character states that I consider plesiomorphic are the absence of a postvertical peak, the large eyes, the separate flagellomeres I and II, the large abdominal terga and sterna with their full complement of setae, the large male tergum X with the horizontal fold cephalad of the cerci, the short ovipositor with large, free, unjuxtaposed cerci, and the presence of a weak Rs wing vein. I believe that the apomorphic character of the long empodia relative to the length of claws is insignificant, because it is a character most conifer cecidomyiids share, regardless of their affinities. The larvae of *Cecidomyia* are basically typical Cecidomyiidi larvae except insofar as they are modified for life in conifer resin.

*Cecidomyia* species are easily distinguishable. Moreover, enough characters are definable into plesiomorphic and apomorphic states that a cladistic analysis of the species is possible. The cladogram (fig. 1) is based on the following 13 characters. Each character is followed first by what I consider to be the plesiomorphic state and then by the corresponding apomorphic state.

(1) Number of papillae on terminal segment of larva: Four, one without seta, two with long, pointed setae; fewer than four, only one with long, pointed seta.

(2) Caudal extensions of terminal spiracles: Short, not longer than wide; long, much longer than wide.

(3) Size and shape of larval spatula: Large, clove-shaped; reduced in size or absent, when present cephalic margin not deeply cleft.

(4) Length of cephalic apodemes of larva: Shorter than head; longer than head.

(5) Number of papillae on terminal segment of larva: Three; two.

(6) Larval spatula: Present; absent.

(7) Setation of dorsal papillae of larva: Middle pair on segments I-VII and two papillae on segment VIII with setae; without.

(8) Shape of terminal spiracle: Bilaterally symmetrical; longer mesally than laterally.

(9) Size of male terminalia: Normal; extremely large.

(10) Dorsum of larval abdomen: Unmodified; with tubercles.

(11) Pupation site: In pitch mass on clear cocoon; apart from pitch mass in opaque cocoon.

(12) Size and shape of larval spatula: Wide cephalic margin, tapering caudally to long shaft; triangular, not longer than wide.

(13) Number of adult palpal segments: Four; three.

The only group of *Cecidomyia* species common to both North America and Eurasia has larvae with dorsal tubercles. It appears to me that the genus had its genesis in North America and that a section was able, for whatever reason, to colonize Eurasia, where speciation occurred before subsequent isolation. This pattern is reflected in another group of cecidomyiids, the large tribe Lasiopterini. The subtribe Alycaulina occurs entirely in the New World, and its sister group, the Lasiopterina, is found throughout most of the world (Gagné, 1969).

## THE NEARCTIC SPECIES

The Nearctic species are treated here alphabetically. Locality data for previously described species are broadly summarized by host and State or Province. The complete collection data are on file in the Diptera Unit, Systematic Entomology Laboratory, U.S. Department of Agriculture, but eventually will be deposited in the Smithsonian archives.

*Cecidomyia* species are recorded from the following native American pine species: *Pinus banksiana* Lamb., *P. caribaea* Morelet, *P. clausa*

(Chapm.) Vasey, *P. contorta* Dougl., *P. echinata* Mill., *P. elliotii* Engelm., *P. glabra* Walt., *P. palustris* Mill., *P. ponderosa* Dougl. ex P. and C. Lawson, *P. radiata* D. Don., *P. resinosa* Ait., *P. rigida* Mill., *P. serotina* Michx., *P. strobus* L., *P. taeda* L., and *P. virginiana* Mill. They include all the pines found in North America east of the Mississippi River except *P. pungens* Lamb., but only four from west of the Mississippi.

## KEYS TO NEARCTIC SPECIES

The adult stage of *C. fortunactus* Gagné is unknown. Females of *Cecidomyia* are too similar for effective discrimination except those of *C. piniinopsis*, which have three instead of the usual four palpal seg-

ments, and *C. candidipes*, on which distalmost hind tarsomeres are covered with white instead of brown scales.

### Males

1. Terminalia very large, much wider than abdominal segments VI and VII ..... 2  
Terminalia smaller (normal), narrower than abdominal segments VI and VII ..... 3
2. Basimere (figs. 8-9) rounded distally, with dense apical bristles covering telomere in caudal view; telomere straight ..... *C. reburrata* Gagné  
Basimere (figs. 10-11) bilaterally narrowed distally, without dense bristles; telomere twisted ..... *C. tortilis* Gagné
3. Palpus three-segmented ..... *C. piniinopsis* Osten Sacken  
Palpus four-segmented ..... 4
4. Sternum X about as wide as aedeagus, simple, rounded apically (fig. 16); hind tarsomeres I-II brown, III-V white ..... *C. candidipes* Foote  
Sternum X definitely wider than aedeagus, at least weakly bilobed apically (figs. 12, 15, 17); hind tarsus uniformly brown ..... 5
5. Aedeagus widest beyond middle; sternum X deeply bilobed (fig. 12) .. *C. resinicola* (Osten Sacken)  
Aedeagus widest at base; sternum X weakly bilobed (figs. 15, 17) ..... 6
6. Sternum X longer than aedeagus, parallel-sided (fig. 15) ..... *C. resinicoloides* Williams  
Sternum X shorter than aedeagus, wider basally than apically (fig. 17) ..... *C. brevispatula* Gagné

### Last-Instar Larvae

1. Abdomen with dorsal tubercles (fig. 27) ..... 2  
Abdomen without dorsal tubercles (fig. 28) ..... 4
2. Middle pair of dorsal abdominal setae not set on tubercles (fig. 37); spatula (fig. 36) almost entirely black; from *P. strobus* ..... *C. candidipes* Foote  
Middle pair of dorsal abdominal setae set on tubercles (figs. 39, 42); spatula (figs. 40, 41) brown; from hard pines ..... 3
3. Spatula long (fig. 40); lateral pairs of dorsal abdominal tubercles weakly bifid (fig. 39) ..... *C. piniinopsis* Osten Sacken  
Spatula short, triangular (fig. 41); lateral pairs of dorsal abdominal tubercles deeply bifid (fig. 42) ..... *C. brevispatula* Gagné
4. Spatula present (figs. 32, 35); middle pair of dorsal abdominal papillae with setae; abdominal segment VIII (bearing hind spiracles) with three pairs of dorsal-pleural setae (figs. 33, 34) ..... 5  
Spatula absent; middle pair of dorsal abdominal papillae without setae (fig. 29); abdominal segment VIII with two pairs of dorsal-pleural setae (figs. 30, 31) ..... 6
5. Spatula large, deeply bifid cephalad (fig. 32); caudal prongs of hind spiracles short (fig. 33) ..... *C. fortunactus* Gagné  
Spatula shorter, weakly bifid cephalad (fig. 35); caudal prongs of spiracles long (fig. 34) ..... *C. resinicoloides* Williams
6. Hind spiracles longer mesally than laterally (fig. 30) ..... *C. resinicola* (Osten Sacken)  
Hind spiracles of equal length mesally and laterally (fig. 31) *C. reburrata* Gagné and *C. tortilis* Gagné

## DESCRIPTIONS OF NEARCTIC SPECIES

### *Cecidomyia brevispatula* Gagné, new species

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (fig. 17): Sternum X concave apically; aedeagus short, wide, slightly notched apically.

**Pupa.**—Unknown.

**Last-instar larva (figs. 41-42).**—Spatula brown, triangular, tiny. Pleural and dorsal abdominal papillae with long setae, situated on tubercles, two lateral pairs of dorsal papillae each on common, forked, anteroposteriorly flattened lobe. Two terminal papillae (as in fig. 39): One with long, tapered seta; one with long, peglike seta.



Holotype, larva, ex *P. elliotii*, Lykes Fire Tower, Glades Co., Fla., 31-V-1973, J. R. McGraw, USNM Type No. 66650. Paratypes: 10 larvae, same data as holotype; male, 3 larvae, *P. elliotii*, Mile Post 65, Interstate 75, J. R. McGraw; 2 larvae, *P. echinata*, Murphy, N.C., 7-15-1970, J. L. Rauschenberger; 2 larvae from pitch mass on branch, *P. clausa*, U. of Fla. campus, Alachua Co., 31-XII-1970, J. R. McGraw; 3 larvae, *P. virginiana*, Wheaton Park, Montgomery Co., Md., Oct. 15, 1965, R. J. Gagné. Several paratypes will be deposited in the Florida State Collection of Arthropods, Gainesville.

**Etymology.**—*Brevispatula*, a noun in apposition, refers to the short, larval spatula.

**Distribution and biological notes.**—*C. brevispatula* was found on several species of pine in the Southeastern United States: *P. clausa* (Fla.), *P. echinata* (N.C.), *P. elliotii* (Fla.), and *P. virginiana* (Md.). The specimens from *P. elliotii* were collected near needle bases of new foliage on expanding terminals in the area of feeding injury of *Rhyacionia subtropica* Miller (Lepidoptera: Olethreutidae); those from *P. virginiana* were found in a small pit near the base of a needle fascicle.

### *Cecidomyia candidipes* Foote

*Retinodiplosis albitarsis* Felt, 1918: 383 (secondary homonym; preoccupied in *Cecidomyia* by Meigen (1803)).

*Cecidomyia candidipes* Foote, 1965: 287 (new name for *albitarsis* Felt).

**Adult.**—Palpus four-segmented. Legs with white scales covering hind tarsomeres III-V, brown scales elsewhere. Male terminalia as in figure 16.

**Pupa.**—Antennal horn pointed anteriorly; pronotum as in figures 22-23.

**Last-instar larva** (figs. 27, 36-37).—Spatula mostly black, occasionally brown anteriorly. Pleural and dorsal abdominal papillae with long setae, no papillae on tubercles except two lateral pairs of dorsals, each situated on common, forked, anteroposteriorly flattened lobe. Three terminal papillae: One with long, tapered seta; one with long, peglike seta; one sometimes not apparent, without seta. Terminal spiracles bilaterally symmetrical, with long, caudal prongs.

Lectotype, male, here designated, from larva in pitch mass on *P. strobus*, Round Lake, N.Y., June 1918, a2917, in Felt Collection, New York State Museum, Albany. Paralectotypes: 4 males, 4 females, 4 larvae, same data as lectotype.

**Distribution and biological notes.**—*C. candidipes* is known only from white pine (*P. strobus*). I have seen specimens from Connecticut, Illinois,

Maryland, New York, Ontario, Pennsylvania, and Quebec. Felt (1918) stated that the larvae transformed to pupae within the pitch masses, but his notebook (unpub.), where complete collection data were generally kept, notes that "larvae of [*albitarsis*] occur in the pitch masses and 3 cocoons, 2 on needles and 1 on bark, were separated." If larvae of *C. candidipes* do leave the pitch masses to pupate, their behavior would fit that of the other two Nearctic species with larval tubercles, *C. piniinopsis* and *C. brevispatula*. I cannot conclude that the presence of the tubercles and the habit of leaving the pitch mass to pupate are correlated, because one European species, *C. magna* (Möhn), that has abdominal tubercles reportedly pupates in the pitch mass.

### *Cecidomyia fortunactus* Gagné, new species

**Adult and pupa.**—Unknown.

**Last-instar larva** (figs. 32-33).—Spatula large, strongly sclerotized, deeply bifid cephalad. Pleural and dorsal abdominal papillae with short setae, no papillae on tubercles. Four terminal papillae: Two each with long, tapered seta; one with long, peglike seta; and one with short, conical seta. Terminal spiracles bilaterally symmetrical with short, caudal prongs.

Holotype, larva, in resin drop on twig, *P. virginiana*, Wheaton Park, Montgomery Co., Md., Apr. 1, 1976, R. J. Gagné, USNM Type No. 66649. Paratypes: 2 larvae, same data as holotype, except IX-22-1976; larva, ex *P. elliotii*, Lykes Fire Tower, Glades Co., Fla., 31 July 1973, J. R. McGraw. Additional record: Larva, ex *P. elliotii*, ex pitch canker diseased terminal, Flagler Co., Fla., 30 July 1974, R. C. Wilkinson (this specimen lost during slide mounting).

**Etymology.**—*Fortunactus* is a telescoped compound name from fortuna (lucky) and nactus (a find). We are fortunate to know this species, if only the larval stage, because it is important in establishing the ground plan of the genus. *Fortunactus* is a noun in apposition.

**Distribution and biological notes.**—*C. fortunactus* is known only from Maryland on *P. virginiana* and from Florida on *P. elliotii*. One of the Maryland paratypes was found in a droplet of pitch that also contained two dead, last-instar larvae of *C. piniinopsis*. The five known specimens of this species were all found singly.

### *Cecidomyia piniinopsis* Osten Sacken

*Cecidomyia piniinopsis* (as *pini inopsis*) Osten Sacken, 1862: 196.  
*Cecidomyia banksianae* Vockeroth, 1960: 73. New synonym.

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (figs. 18-19): Sternum X concave apically; aedeagus approximately as long as sternum X, parallel-sided, blunt apically.

**Pupa.**—Antennal horn pointed anteriorly; pronotum as in figure 24.

**Last-instar larva (figs. 38-40).**—Spatula brown, widest cephalad, tapering abruptly behind, cephalic edge straight. Pleural and dorsal abdominal papillae with long setae, situated on tubercles, two lateral pairs of dorsal papillae each on common, oblong, anteroposteriorly flattened lobe. Two terminal papillae: One with long, tapered seta; one with long, peg-like seta. Terminal spiracles bilaterally symmetrical, with long, caudal prongs.

**Types of names in this taxon.**—

*C. piniinopsis* O. S.: Syntypes, 5 cocoons, deposited in Museum of Comparative Zoology, Cambridge, Mass., and an undetermined number of larvae (lost, if originally kept) taken on *P. virginiana* (as *P. inops*) IV-V, 1861, Washington, D.C., Osten Sacken. *C. banksianae* Vockeroth: Holotype, male, from *P. banksiana*, Stead, Manitoba, VI-1957, W. A. Reeks, Type No. 6833, in Canadian National Collection, Ottawa.

**Remarks.**—All that exist of Osten Sacken's type-series of *C. piniinopsis* are five cocoons that are not diagnostic and are the same as formed by *C. brevispatula*, which is also found on *P. virginiana*. Osten Sacken noted that the dorsal tubercles of the larvae were oblong. That character will separate *C. piniinopsis* from *C. brevispatula*, which has forked tubercles.

**Distribution and biological notes.**—*C. piniinopsis* and *C. resinicola* are the two most widely distributed species of *Cecidomyia*. Both occur on many species of hard pine (*Diploxylon*) in eastern North America and in the West. I have seen specimens of *C. piniinopsis* from *P. banksiana* (Mich., Ontario, Wis.), *P. contorta* (Brit. Col., Yukon Ter.), *P. elliotii* (Fla.), *P. ponderosa* (Ariz., Brit. Col., Calif., Idaho, Oreg., Wash.), *P. rigida* (Maine, Md., N.Y., N.C.), *P. strobus* (Md.), *P. virginiana* (D.C., Md., Va.), and *P. sp.* (Ark.).

Larvae of *C. piniinopsis* usually occur singly in small pitch droplets and sometimes in inconspicuous pockets at the base of needles. Full-grown larvae leave the pitch mass, weave a white cocoon (fig. 4) some distance away on the twig, candle, or needle, and pupate immediately. Adults emerge within a few days. Miller (1958) suggested that there were up to four broods yearly on *P. rigida* in Ohio. I have

reared adults in September so that there are at least two generations in Maryland. Generations probably overlap. I found one larva of each of the three instars in September in Maryland in a small twig wound. The species survives the winter in the larval stage, and cocoons are much more numerous and larvae more readily found in early spring than at other times. Reeks (1960) noted that infested buds or shoots may be killed by this species, but he did not find it common enough to consider economically important.

I reared a series of the small, black *Platygaster diplosidis* (Ashmead) (Platygasteridae) specimens from each of several cocoons of *C. piniinopsis* and, on one occasion, a single large, green-metallic *Habrocytus* sp. (Pteromalidae).

***Cecidomyia reburrata* Gagné, new species**

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (figs. 8-9): Greatly enlarged; basimere with dense apical patch of long setae hiding telomere in caudal view; telomere situated mesoapically on basimere, bilaterally compressed.

**Pupa.**—Antennal horn rounded anteriorly; pronotum as in figure 31.

**Last-instar larva.**—Spatula absent. Pleural papillae and lateral pairs of dorsal papillae of abdomen with short setae, no papillae on tubercles; middle pair of dorsal papillae without setae or, on abdominal segment VIII, not apparent. Three terminal papillae: One with long, tapered seta; one with long, peglike seta; and one with short, conical seta. Terminal spiracles (as in fig. 31) bilaterally symmetrical, with long, caudal prongs.

Holotype, male, emerged May 19, 1975, from larvae collected April 18 in wound on *P. taeda*, Cedarville State Forest, Charles Co., Md., R. J. Gagné, USNM Type No. 66647. Paratypes: 2 males, 2 pupal exuvia, 6 pupae, 6 larvae, same pertinent data as holotype; male, Florida Caverns State Park, Jackson Co., Fla., 26-V-1973, malaise trap, W. W. Wirth; larva, 3 females, 3 pupal exuvia, *P. taeda*, 10-11 mi. sw. Alexandria, La., 26-III-1960, J. G. Chillcott; 2 males, female, *P. taeda*, Grangeville, La., IV-2-1968, D. K. Pollet; male, female, *P. taeda*, Livingston, La., IV-16-1968, D. K. Pollet; 1 larva, 4 males, 4 pupal exuvia, *P. taeda*, Turkey Creek, La., III-28-1960, J. G. Chillcott; 20 larvae, 4 males, 4 females, *P. caribaea*, Punta del Rio, Cuba, II-23-1928, S. C. Bruner. Several paratypes will be deposited in the Florida State Collection of Arthropods, Gainesville.

**Etymology.**—*Reburrata* is an adjective meaning

bristly, in reference to the strong, dense setae on the male terminalia.

**Distribution and biological notes.**—*C. reburata* is known from southern Maryland to Florida on *P. taeda* and from Cuba on *P. caribaea*. It is responsible for large, pitch-filled nodes on twigs and branches in which the larvae, up to 1 cm in length, live gregariously. Pupation occurs in silken tubes within the pitch masses.

### *Cecidomyia resinicola* (Osten Sacken)

*Diplosis resinicola* Osten Sacken, 1871: 345.

*Retinodiplosis palustris* Felt, 1915: 408. New synonym.

*Cecidomyia reeksi* Vockeroth, 1960: 70. New synonym.

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (figs. 12-14): Sternum X long, wide, parallel-sided, deeply bilobed apically; aedeagus widest beyond middle, blunt apically, a mesal notch sometimes present.

**Pupa.**—Antennal horn ridged anteriorly; pronotum with long tubercle at each side of center line (fig. 25).

**Last-instar larva (figs. 29-30).**—Spatula absent. Pleural papillae and lateral pairs of dorsal papillae of abdomen with short setae, none on tubercles; middle pair of dorsal papillae without setae or, on abdominal segment VIII, setae not apparent. Four terminal papillae: One with long, pointed seta; one with long, peglike seta; one with short, conical seta; and one when present without seta. Terminal spiracles longer mesally than laterally, with long, caudal prongs.

**Types of names in this taxon.**—

*C. resinicola* (O.S.): Lectotype, here designated, male, from pitch mass on *Pinus "inops,"* Tarrytown, N.Y., 1871, Osten Sacken, deposited in Museum of Comparative Zoology, Cambridge, Mass. Paralectotypes: 11 pupal exuvia in pitch mass, 3 males, 7 females, same data as lectotype. Paralectotype larvae, if originally kept, possibly turned into pupae, of which we now have pupal exuvia.

*C. palustris* (Felt): Lectotype, here designated, male, reared from pitch mass on *Pinus palustris*, Talladega, Ala., April 9 (not May 20, as stated in original description), 1915, J. J. Davis, C a2622, in Felt Collection, New York State Museum, Albany. Paralectotypes: Male, 2 females, pupal exuvium, same data as lectotype.

*C. reeksi* Vockeroth: Holotype, male, Stead, Manitoba, May 1957, W. A. Reeks, Type No. 6832, in Canadian National Collection, Ottawa.

**Distribution and biological notes.**—*C. resinicola* and *C. piniinopis* are the two most widely distributed

species of this genus. Both occur on almost all the hard pines (*Diploxylon*) in eastern North America and on several species in the West. I have seen specimens of *C. resinicola* from *P. banksiana* (Mass., Mich., N.W.T., Ontario), *P. contorta* (Brit. Col., Oreg.), *P. echinata* (La.), *P. elliotii* (Fla.), *P. glabra* (Fla.), *P. palustris* (Ala.), *P. ponderosa* (Calif., Colo., Idaho, N. Mex.), *P. radiata* (Calif.), *P. rigida* (Md., Mass., N.J., N.Y., N.C., Ohio, Ontario, Pa.), *P. serotina* (N.C.), *P. taeda* (Ga., Md., Miss., Va.), and *P. virginiana* (Md., Va.).

*C. resinicola* may occur singly in small droplets of pitch (fig. 5) or gregariously in larger pitch masses (fig. 3) as well as pitch-filled nodules. The species overwinters in the larval stage. In early spring, larvae pupate in the pitch mass, and adults emerge a few days later. The adults are short lived. The females lay their eggs singly on all plant parts but not on fresh pitch (Reeks, 1960). After hatching, the larvae crawl to pitch masses and embed themselves. Reeks reported that there was one generation a year on *P. banksiana* in Manitoba, but Miller (1958) suggested the possibility of four overlapping broods on *P. rigida* in Ohio. Although full-grown larvae can be found on *P. virginiana* in the summer, they are not as common as in the spring.

Reeks (1960) found that the damage caused by the feeding of *C. resinicola* larvae could kill shoots, but he did not consider it very serious in the Prairie Provinces. He found larval incidence greater on open growing trees in poor sites. Keen (1938, 1952), treating more than one species under the heading, "pine pitch midges," found that their damage to tips of *P. ponderosa* in Oregon was so severe as to deform and in some cases to kill the trees. Interestingly, he found them responsible for "birdseye pine," a desirable condition in wood used for finishing purposes. This is due to the healing over and consequent distortion of the annual rings around the old feeding pits of *Cecidomyia* sp. (illus. in Keen (1938, 1952)).

On several occasions I reared a large, green-metallic *Habrocystus* sp. (Pteromalidae) from resin masses of *C. resinicola*. Eckel (1903) reared *Platygaster diplosidis* (Ashmead), a platygasterid I found only on *C. piniinopis*, a *Eupelmus* sp. (Eupelmidae), and *Systasis diplosidis* Eckel (Pteromalidae). Miller (1958) also reported this last species from *C. resinicola*.

### *Cecidomyia resinicoloides* Williams

*Cecidomyia resinicoloides* Williams, 1909: 2.

*Cecidomyia accola* Vockeroth, 1960: 76. New synonym.

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (fig. 15): Sternum X long, wider than aedeagus, parallel-sided, concave apically; aedeagus shorter than sternum X, parallel-sided, broadly rounded apically.

**Pupa.**—Not seen.

**Last-instar larva (figs. 34-35).**—Spatula short, narrow, weakly bifid cephalad. Pleural and dorsal abdominal papillae with short setae, no papillae on tubercles. Two terminal papillae: One with long, tapered seta; one with long, peglike seta. Terminal spiracles bilaterally symmetrical, with long, caudal prongs.

**Types of names in this taxon.**—

*C. resinicoloides* Williams: Lectotype, here designated, male, "Stan. Univ., Cal., coll. by R. W. Doane, 1930," in Felt Collection, New York State Museum, Albany. Paralectotype: Female, same data as male. These two specimens are evidently the only two extant specimens of the original type-series (Arnaud, 1970), which also included at least eggs, larvae, and pupae if not other adults.

*C. accola* Vockeroth: Holotype, male, Espanola, Ontario, June 2, 1958, Type No. 6834, in Canadian National Collection, Ottawa.

**Distribution and biological notes.**—*C. resinicoloides* is widely distributed across North America but not collected as frequently as *C. resinicola* or *C. pininopsis*, two other widespread species. I have seen specimens from *P. banksiana* (Ontario), *P. contorta* (Alberta), *P. elliottii* (Fla.) associated with *Cronartium* canker, *P. ponderosa* (Ariz.), *P. radiata* (Calif.), and *P. virginiana* (Md., Va.).

This species pupates in silken tubes in the pitch masses. Williams (1909) thought it likely that there was but one generation annually. He found the larvae most often in large numbers in the pitch masses with sometimes more than 50 in the same

nodule. He reported that *Syntasis diplosidis* Eckel (Pteromalidae) was reared from this fly.

***Cecidomyia tortilis* Gagné, new species**

**Adult.**—Palpus four-segmented. Legs covered with brown scales. Male terminalia (figs. 10-11): Greatly enlarged; basimere with apicolateral margin expanded to partially cover telomere in caudal view; telomere situated mesoapically on basimere, weakly sinuate and twisted.

**Pupa.**—Antennal horn rounded anteriorly, pronotum as in figure 26.

**Last-instar larva (figs. 28, 31).**—Spatula absent. Pleural papillae and lateral pairs of dorsal papillae of abdomen with short setae, none on tubercles; middle pair of dorsal papillae without setae or, on abdominal segment VIII, not apparent. Three terminal papillae: One with long, tapered seta; one with long, peglike seta; and one with short, conical seta. Terminal spiracles (as in fig. 31) bilaterally symmetrical, with long, caudal prongs.

Holotype, male, emerged V-2-1976, from larvae collected IV-1-1976 in wound on *P. virginiana*, Wheaton Park, Montgomery Co., Md., R. J. Gagné, USNM Type No. 66648. Paratypes: 5 larvae, 7 pupal exuvia, 2 males, 4 females, same pertinent data as holotype (USNM); 15 larvae, 8 pupal exuvia, 1 male, 6 females, in pitch wound, *P. clausa*, Panama City, Bay Co., Fla., 23-III-1976, adults reared 25-VI-1976, C. W. Chellman (USNM, Fla. Collect. Arth.).

**Etymology.**—*Tortilis* is an adjective meaning twisted, in reference to the slightly twisted telomere of the male terminalia.

**Distribution and biological notes.**—Gregarious larvae of *C. tortilis* were found in pitch-filled woody swellings on twigs of *P. virginiana* in Maryland and *P. clausa* in Florida. They pupated in silken tubes within the pitch mass.

## THE PALEARCTIC SPECIES

***Cecidomyia pini* (De Geer)**

*Tipula pini* De Geer, 1776: 417.

*Cecidomyia pinimaritimae* (as *pini maritimae*) Dufour, 1838: 294.

Synonym by Borries (1891) and authors.

*Cecidomyia pilosa* Brems, 1847: 31, 61. Synonym by Borries (1891) and authors.

For illustrations of all stages, see Tubeuf (1930); of male terminalia, Mohn (1955b); of larva, Möhn (1955a).

**Types of names in this taxon.**—

*C. pini* (De Geer): Syntypes, all life stages and

cocoons, not seen; not in Swedish Museum of Natural History (P. I. Persson, pers. commun.).

*C. pinimaritimae* Dufour: Syntypes, 2 females, 2 cocoons, from resin of *Pinus pinaster* Ait. (*P. maritima* Mill.), sw. France. I do not know if types exist or, if so, where, but females and cocoons are not diagnostic.

*C. pilosa* Brems: Type in poor condition, covered with fungal hyphae, sex undetermined, "Bre./Lindau" [nr. Zurich], in Entomologisches Institut, Eidgenössischen Technische Hochschule, Zurich. Information provided by W. Sauter of that institute.

**Remarks.**—According to the literature on *C. pini* as summarized in Barnes (1951), this species occurs on pines, fir, and spruce. Possibly more than one species is represented under this name. Synonymy of the three available names has been based on similarities of the biology and gross anatomical characters, not comparison of male terminalia of specimens from the various hosts. Unlike *C. magna* (Möhn), larvae of *C. pini* leave the pitch mass to spin cocoons in which they pupate.

### *Cecidomyia magna* (Möhn)

*Stelechodiplosis magna* Möhn, 1955b: 141.

Description in Möhn (1955b), including illustrations of male terminalia, larval spatula, and larval terminal segments.

Holotype, male, "an Fichte," Hebertshausen (nr. Munich), Germany, IV-22-1954, Nr. 552-T, in E. Möhn Collection.

**Remarks.**—This species is known only from spruce. It pupates in the resin mass unlike all the other species whose larvae have dorsal tubercles.

### *Cecidomyia*, new species

This undescribed species is known from a male, a female, and three larvae in the U.S. National

Museum of Natural History. They are from *Pinus roxburghii* Sarg. in Pakistan. The larvae have dorsal tubercles as do the other non-American species, and the male terminalia are distinct from the two European species as illustrated in Möhn (1955b). I have not described this species here because the male genitalia are slightly distorted on the slide, and I do not know whether the larvae leave the resin mass to pupate.

### ?*Cecidomyia* species

*Cecidomyia* sp. Stebbing, 1905: 430.

This Indian species may be a *Cecidomyia*, but one cannot be sure from the description and illustrations in Stebbing (1905). The larva has pleural and laterodorsal tubercles the length of the body, but the conspicuous hind spiracles one would expect to find on a *Cecidomyia* are not illustrated. Instead, Stebbing notes that the larva is pointed at both ends. Also, known *Cecidomyia* species with tubercles do not have them on the thorax as Stebbing's illustration shows. The larvae of this species feed on resin and are responsible for a gall on *Pinus roxburghii* Sarg. (*P. longifolia* Roxb. not Salisb.) in northern India. They cause a foreshortening of the growing tip that resembles a pine cone. When fully grown, the larvae leave the gall to pupate nearby in white cocoons.

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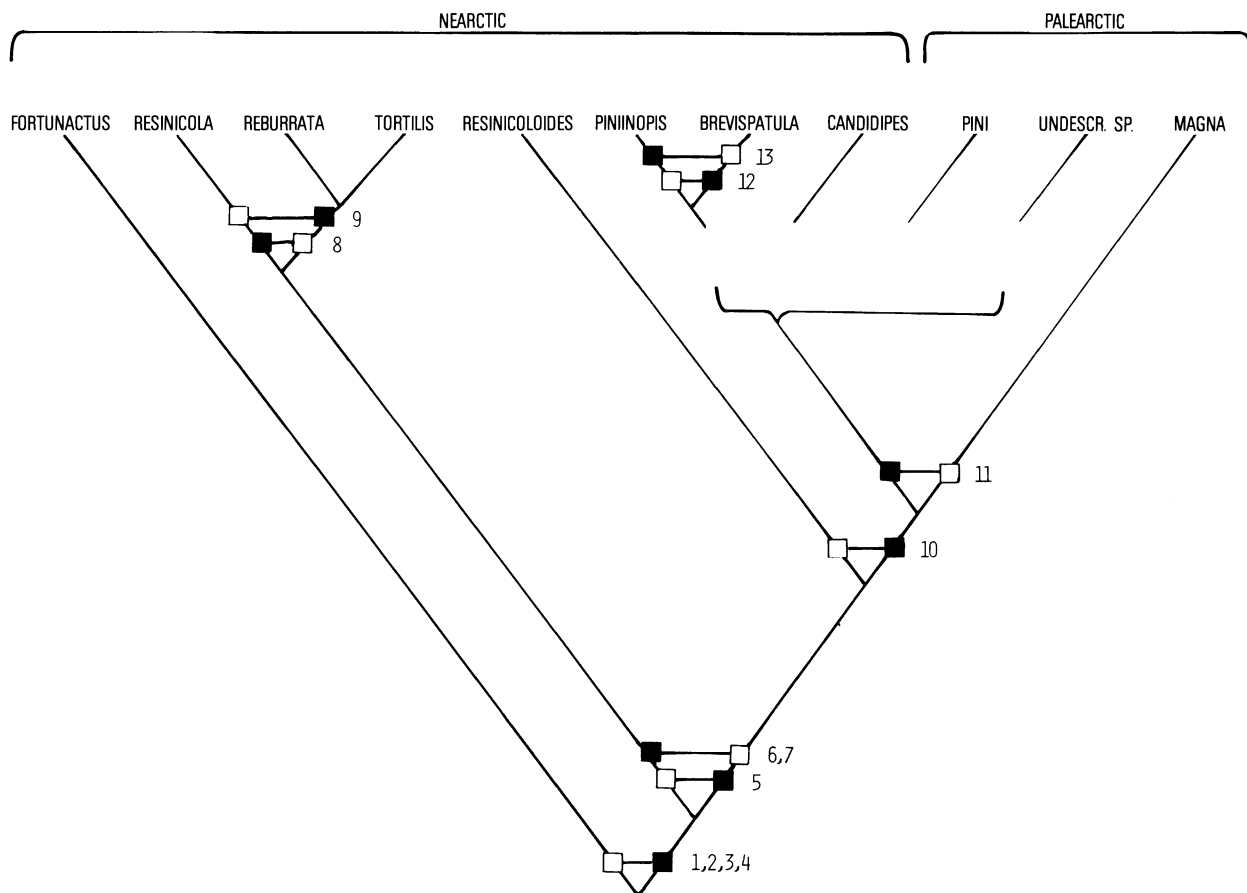


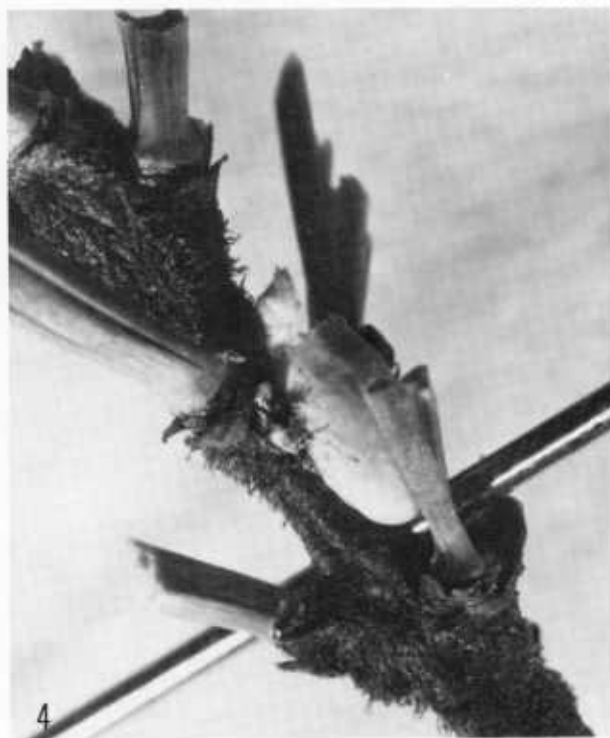
Figure 1.—Cladogram for *Cecidomyia* species.



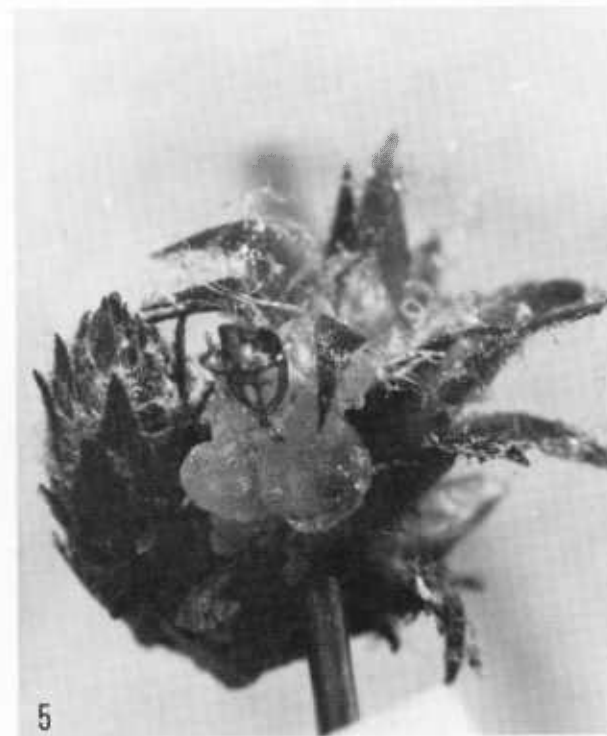
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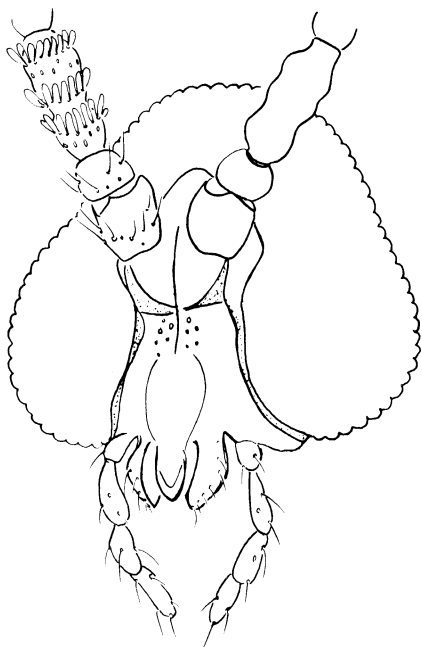
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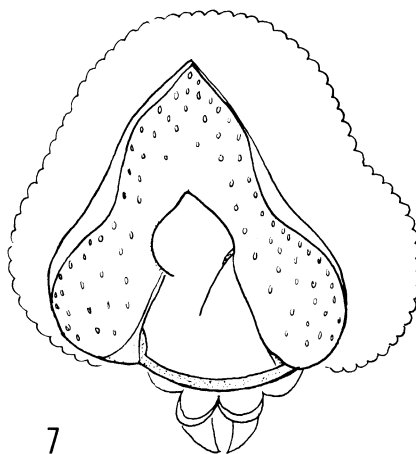
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Figures 2-5.—Galls of *Cecidomyia* with pupal exuvia and cocoon: 2, *C. tortilis* nodule on *Pinus clausa*, Panama City, Fla.; 3, *C. resinicola* pitch mass on *Pinus rigida*, Burlington County, N.J.; 4, *C. piniinopsis* cocoon on *P. strobus*, Charles County, Md.; 5, *C. resinicola* pitch mass on *P. virginiana*, Beltsville, Md.

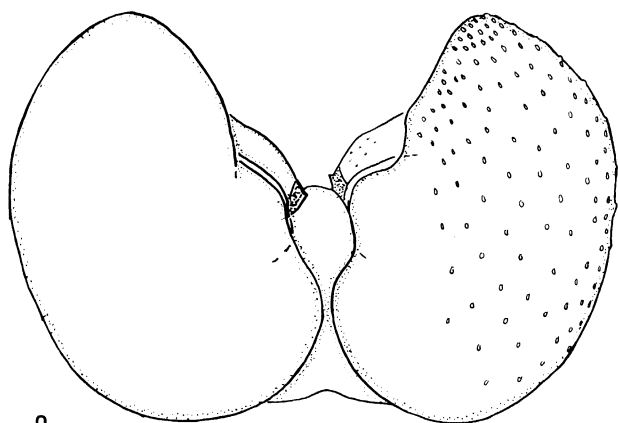




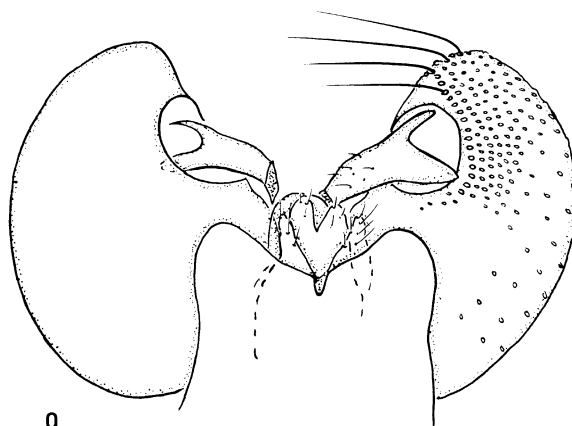
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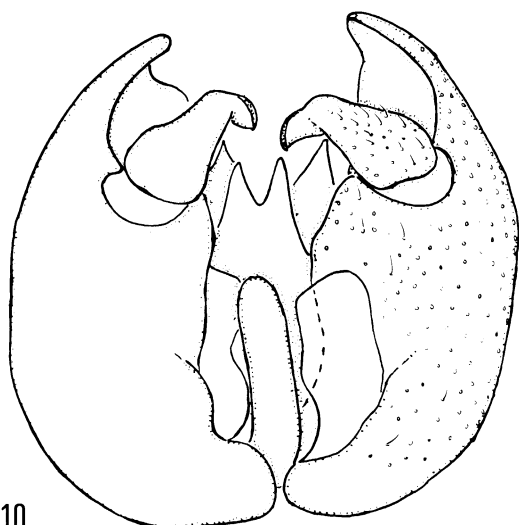
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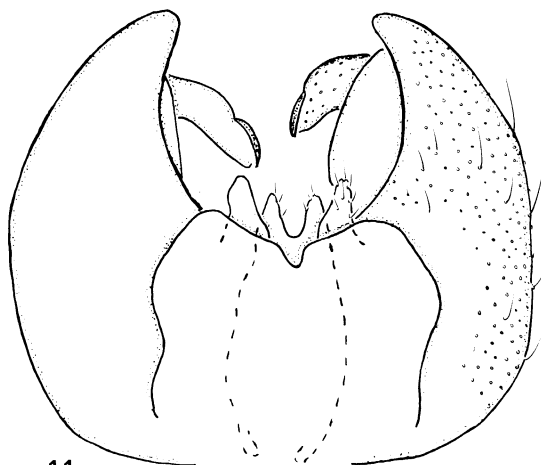
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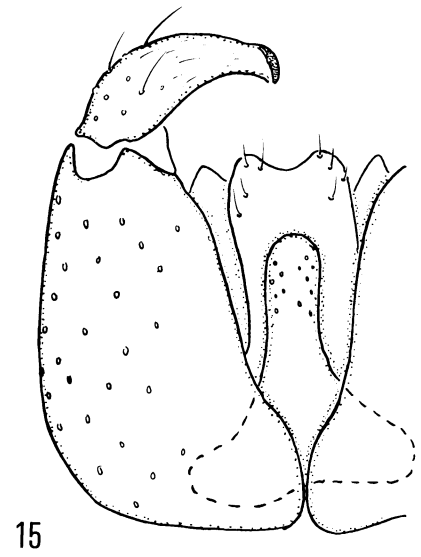
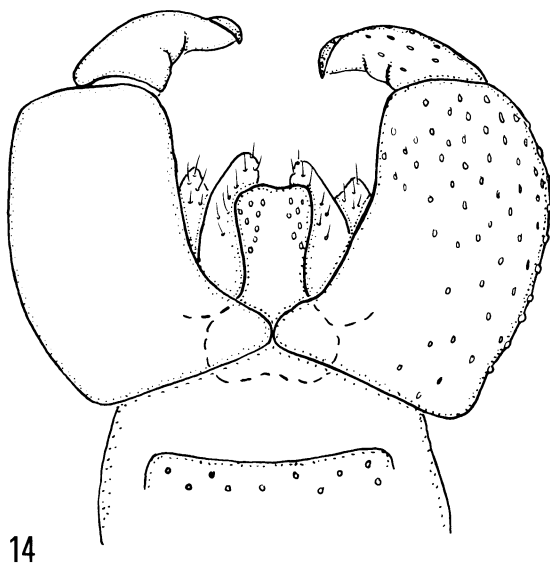
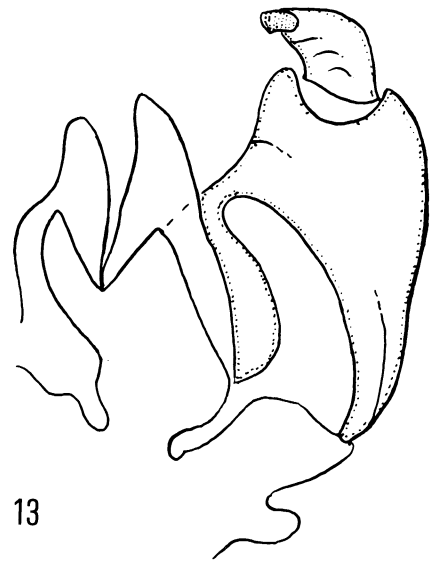
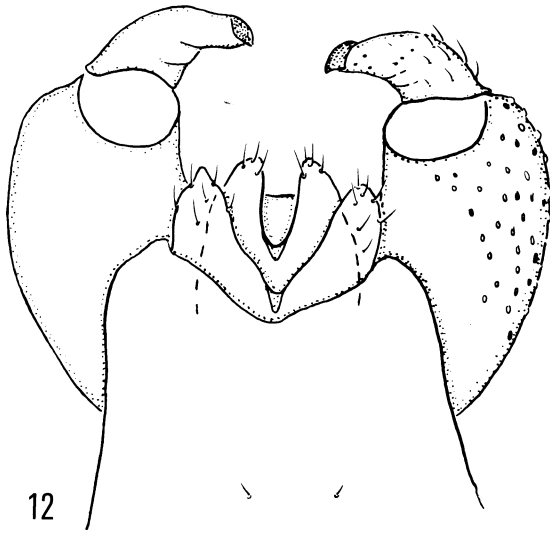


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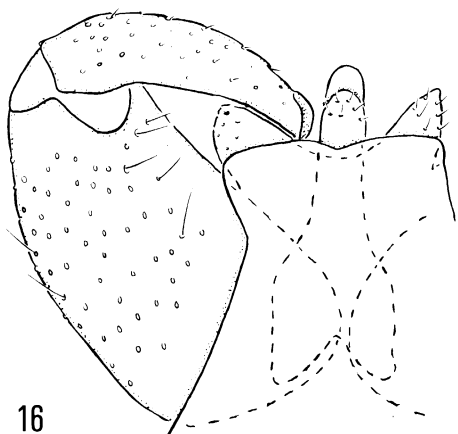


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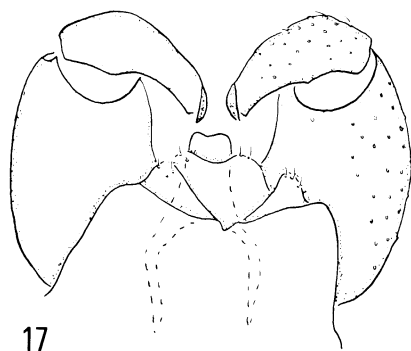
Figures 6-11.—Head and male terminalia: 6-9, *C. reburrata*; 10-11, *C. tortilis*.



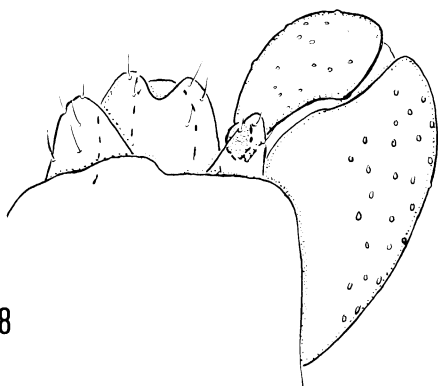
Figures 12-15.—Male terminalia: 12-14, *C. resinicola*; 15, *C. resinicoloides*.



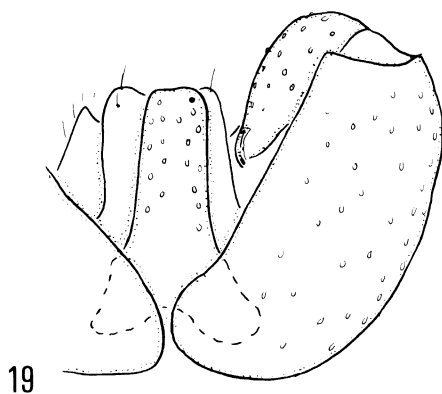
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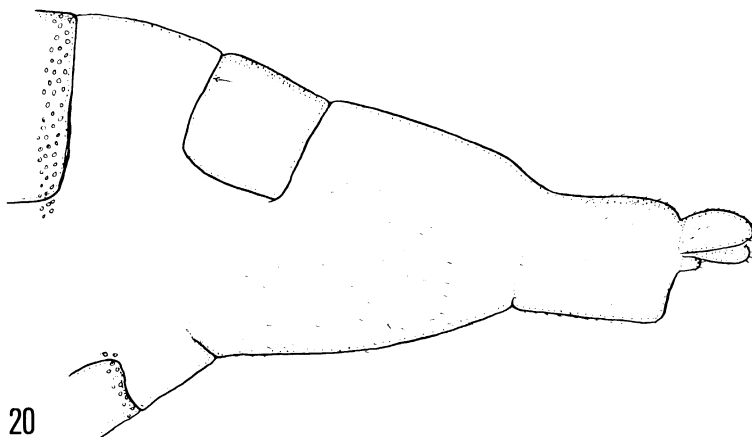
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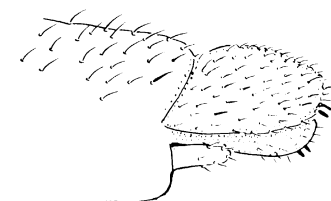
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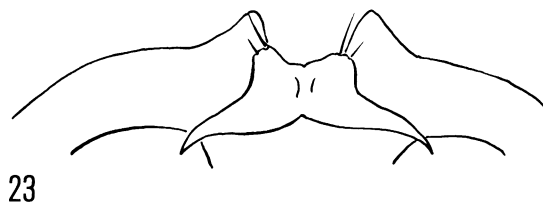
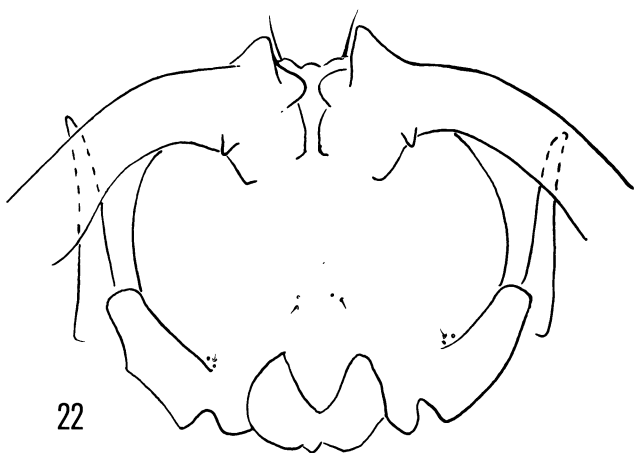


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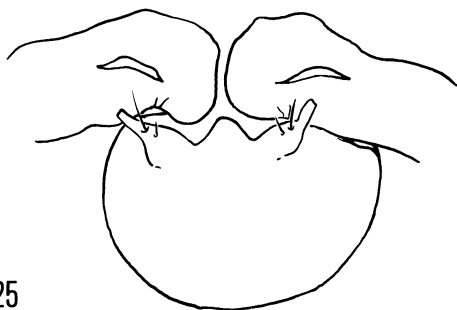
Figures 16-21.—Male terminalia and ovipositor: 16, *C. candidipes*; 17, *C. brevispatula*; 18-19, *C. piniinopis*; 20-21, *C. resinicola*.



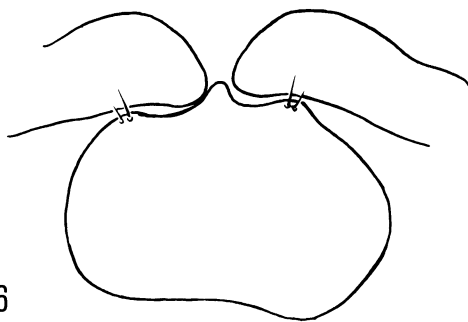
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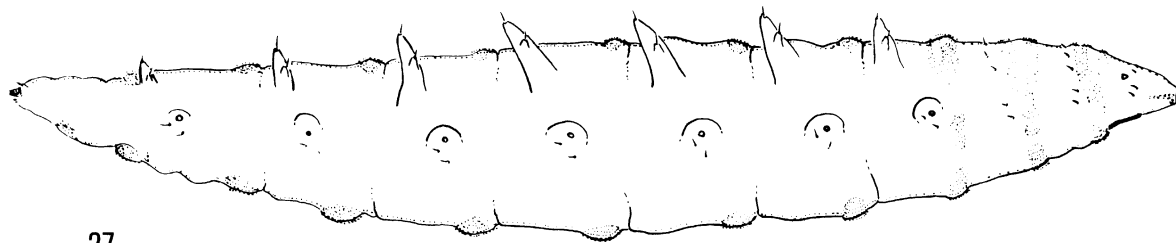


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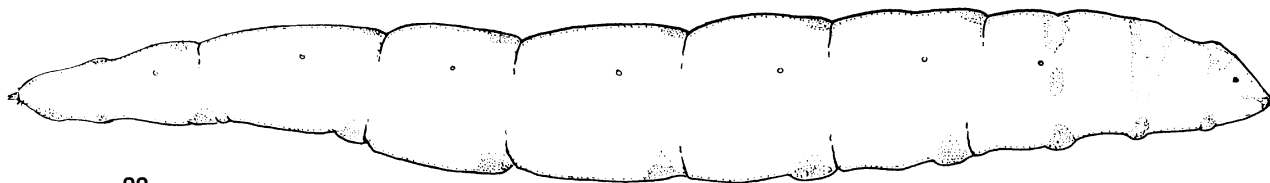


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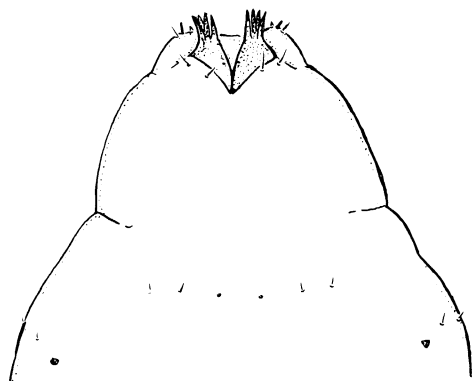
Figures 22-26.—Pupal head (ventral view) and pronotum (anterior view): 22-23, *C. candidipes*; 24, *C. piniinopis*; 25, *C. resinicola*; 26, *C. tortilis*



27



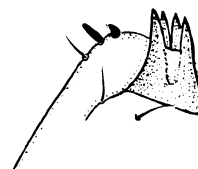
28



29

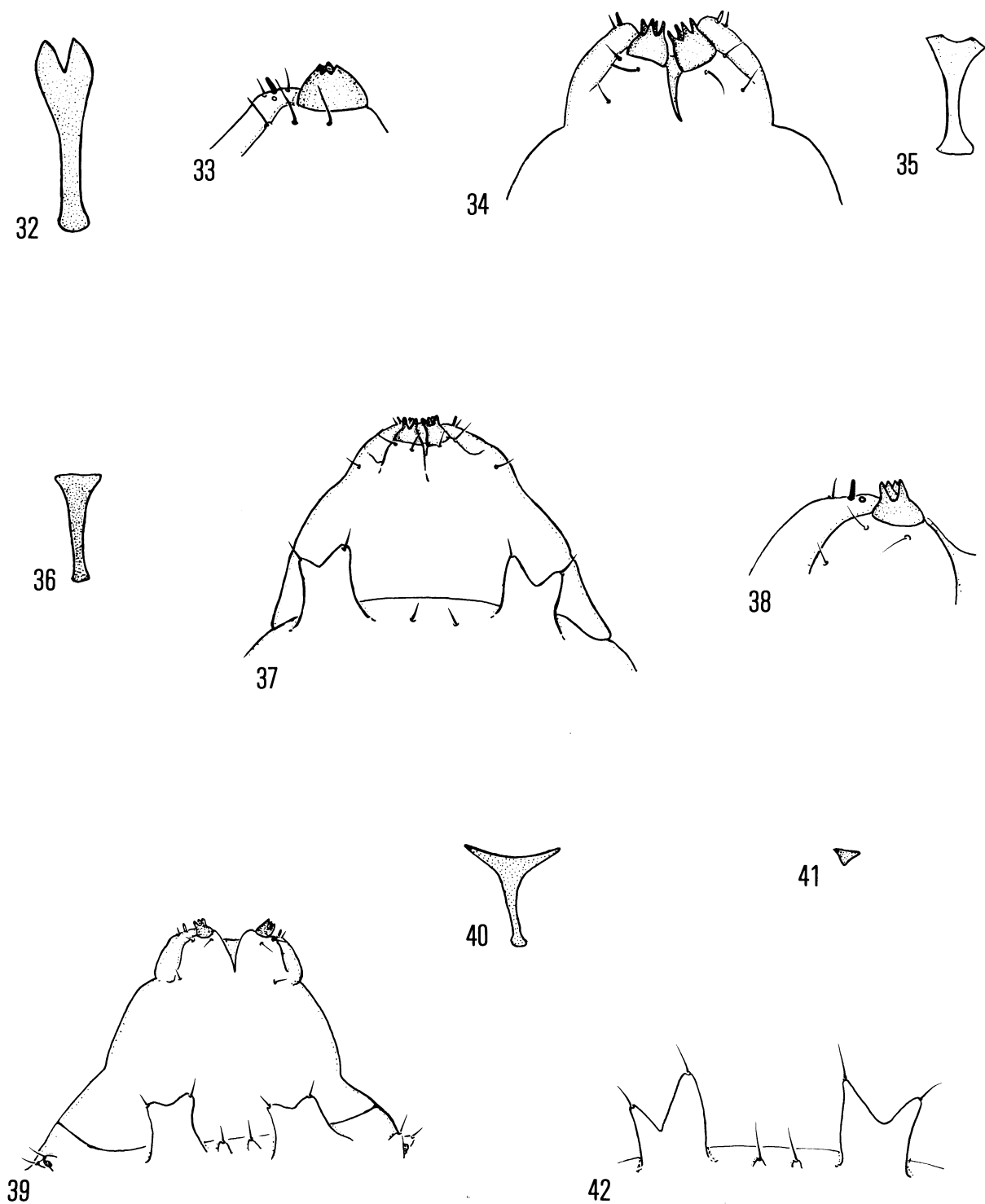


30



31

Figures 27-31.—Larvae and larval terminal segments: 27, *C. candidipes*; 28, *C. tortilis*; 29-30, *C. resinicola*; 31, *C. tortilis*.



Figures 32-42.—Larval terminal segments and sternal spatulae: 32-33, *C. fortunatus*; 34-35, *C. resinicoloides*; 36-37, *C. candidipes*; 38-40, *C. piniinopis*; 41-42, *C. brevispatula*.



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